

NOYES (H.D.)
OPHTHALMOLOGY

IN THE
LAST QUARTER CENTURY.

AN ADDRESS BEFORE THE
Medical Society of the State of New York,

BY

HENRY D. NOYES, M.D.,

PROFESSOR OF OPHTHALMOLOGY AND OTOTOLOGY IN BELLEVUE
HOSPITAL MEDICAL COLLEGE, SURGEON TO THE
NEW YORK EYE AND EAR INFIRMARY.

FEBRUARY 1879.

SYRACUSE, N. Y. :
TRUVAIR, SMITH & BRUCE, PRINTERS AND BINDERS.
1879.

With compliments of

Henry D. Hayes, - W. D.,

233 Madison Avenue, New York.

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ADDRESS
ON THE
Progress of Ophthalmology
DURING THE LAST QUARTER CENTURY.

BY HENRY D. NOYES, M. D., NEW YORK.

ARGUMENT—Introductory Remarks—Some of the Notable Men who Inaugurated this Era—Anatomy and Physiology of the Retina—Measurement of the Acuity of Vision—The Eccentric Portions of the Retina and the Visual Field—Color Perception—Errors of Refraction—Affections of Ocular Muscles—Conical Cornea,—Cataract—The Ophthalmoscope—Glaucoma—Some of the Lesions of the Inner Eye—Diseases of the Inner Eye Dependent on Morbid Constitutional Conditions—Connection Between Affections of Sight and the Physiology of the Brain.

Mr. President and Members of the Medical Society of the State of New York :

A recent writer remarks that the science of ophthalmology one hundred years ago consisted of three things, ophthalmia, cataract and amaurosis. Gradual development enlarged these boundaries, but when at the middle of this century the eye mirror was invented, which makes known the secrets of the inner eye, a prodigious expansion of the science took place.

As I attempt to fulfill the duty which has been laid upon me of addressing you upon this subject, I gratefully appreciate the honor, but am oppressed with embarrassment to make a fit selection from the various topics which seek presentation. I recognize the propriety of attempting only upon such an occasion, a broad and graphic outline of the field of study ; but the spaces to be traversed are so wide that I am beset by the fear of falling into one of two dangers—either to leave no valuable impression by a vague brevity which shall do little more than repeat a catalogue of hard names—or to weary you by a prolixity which would not befit the hour.

Without further apology and trusting to your indulgence, let me allude to the men who introduced this bright era in

ophthalmology. In 1851 Helmholtz invented the ophthalmoscope. He has continued to labor in the field of science and now holds the chair of physics in the University of Berlin. His book on physiological optics has had no peer in modern days and ranks with the profound productions of Newton and La Place. In 1850, Albrecht von Graefe, then twenty-one years old, began practice in Berlin as an oculist. In 1870 he finished a career, which for fruitfulness and brilliancy, has never been equaled in medicine. He was a clinician in the most eminent sense; he was the great promoter of the revolution in ophthalmology. In the *Archiv für Ophthalmologie* which he founded in 1854, Donders, a Dutch professor of physiology, took part, and in 1860 wrote what he modestly styled an essay on ametropia and its results, which was afterwards enlarged and translated into English at the request of the New Sydenham Society, under the title of *Accommodation and Refraction of the Eye*. That book is the oculist's daily companion. In England, Mr. Bowman, who had written admirably on physiology and also made reputation as a surgeon, found himself enamored of the growing science and is to-day the Nestor of British ophthalmologists. I cannot continue the list of noble names. I cannot even stay to call your attention to the prolific literature which has grown up. I can only say that not less than ten important journals are occupied in promoting its culture and recording its progress.

On the *anatomy* of the eye, a few statements may be interesting. The histology of many parts such as the cornea, the crystalline, the vitreous, the ciliary muscle, and, above all, the retina was not fully investigated until within a recent period. Let me single out the retina for illustration. Its complex and delicate structure was slowly unraveled, but success was not complete until the modern methods of preparation of tissues for microscopic study had been devised. Gradually, one after another, the minute elements were revealed, their individuality recognized, their relations established and the frame-work of connective tissue, which supports and separates them, made out. Finally, we receive the diagrammatic scheme of how the whole is made up, and we are told that in a membrane which is in different parts 0.4 mm. to 0.1 mm. thick, we have ten separate layers. We find at

the posterior end of the optical axis a spot which is about 0.2 mm. in diameter and which forms a slight pit. Here we have the most acute sight, and we find some layers disappear while others attain their highest development. We learned from Mariotte, in 1668, that the optic nerve is insensitive to light and gives us a blind spot in the field of vision, but we did not know until 1877 that the periphery of the retina on its temporal side for a breadth amounting to between three and four millimeters and covering an angle of about 30° , is incapable of light perception. This region we never use because the nose cuts it off, and we therefore know nothing of the lack of function.

One of the retinal layers may arrest our attention, viz: The bacillary layer made up of rods and cones in varying proportions. They are put together in regular array as if the concave surface were set like a brush with bristles. They are longest at the central spot and most numerous. The capacity to discriminate objects is in direct proportion to the number which are packed into a given area. Their outer ends are planted upon the layer of pigment cells which serve to dampen the rays of light. Each cone or rod is in connection with a fibre of the optic nerve, and these go into the brain. But what function is to be assigned to the various structures of the retina, which intervene between the bacilli and the optic nerve fibre, we do not know. We have certainly attained something, to learn so much concerning this transparent and frail tissue. But scarcely have we paused in our self-gratulation, when from an unexpected quarter another element comes to plague our wits and stagger our self conceit. We are told by Profs. Boll and Kühne that this complex structure is after all only the dead retina, that in the living tissue a coloring matter resides, a purplish red, which is discharged by the light and constantly renewed, and which is so fugitive that it will endure but for a few seconds. If a certain process is followed, the coloring matter may be modified and preserved so as to show a picture upon the retina just as a photographer develops a portrait upon his sensitized plate. The experiment is as follows: A rabbit is kept in the dark for an hour, then his eyes exposed for ten minutes to a bright window across which narrow slats have been nailed, leaving inter-spaces; he is then beheaded and the eyes enucleated

and examined by a sodium light in a dark room. The retina, to make it tough enough to handle, has been for twenty-four hours laid in a solution of alum, and there upon its *back* side is found a picture of the window bars and spaces; in other words an optogram. The color which causes these effects is found only upon the outer-half of the rods, and is thought to be secreted by the pigment cells. A large number of interesting details have been discovered on this subject, and it suggests many curious speculations. Especially does it suggest that our theories how the retina perceives and discriminates color, may have to be greatly modified. But I cannot dwell on the theme.

A subject which naturally unfolds from the anatomy and physiology of the retina is the estimation of the ordinary capacity for sight. In other words what is the standard degree of vision, which we have a right to assume. Clearly we must have a measure by which to gauge variations from correct sight. This has been furnished to us only within twenty years. Jaeger first printed a series of type in graduated order, but Snellen attacked the problem in a scientific manner. He did not attempt to set up a standard of extremely acute vision, but to determine what is the usual and average degree. Evidently this can only be expressed in terms of angles. It was found that an object whose image subtends at the optical centre an angle of one minute is in moderate light easily seen by good eyes. The letters of the alphabet are the objects which we have the greatest need to recognize. If now we take the length of a letter to bear to the width of the stroke which composes it, the ratio of five to one, we have an object which we can use as a standard, to measure acuity of sight. Suppose the capital letters to be enclosed in a square whose sides form an angle of five minutes and the stroke of the letters to be one-fifth of this measure—we have the unit on which the modern system of testing vision is founded. If the type designated as XX (twenty) is placed at twenty feet distance, the eye which reads it has vision equal to 1; or expressed in the correct formulas it is the product of the distance divided by the number of the type, or $\frac{20}{20}$. If only No. XL be used at 20 feet, then $V = \frac{20}{40}$ or $\frac{1}{2}$, if only C be used, then we say $V = \frac{20}{100}$ or $\frac{1}{5}$. By this method we are able to judge with accuracy, and record such results correctly.

Nothing has done more to advance ophthalmology than the adoption of this system. Without it we should be like one who tries to write without having an alphabet.

But this test only gauges the capacity of one small spot of the retina, viz: The fovea centralis at the extremity of the visual line. Shall we not take account of the remaining retina? We find on very slight experiment that the perceptive power rapidly declines as we leave the centre. Thus if at 20 feet distance we give attention to an object placed at 10 inches from the point of fixation, the acuity of vision declines from $\frac{3}{4}\%$ to $\frac{2}{10}\%$. This base line makes an angle of about 2° at the nodal point with the visual axis, and corresponds to a distance from the centre of the fovea, of about half a millimeter. The space upon the retina which possesses the acuity of $\frac{3}{4}\%$ is only about 30 to 35 minutes of angle, and this corresponds to a linear measurement of about .13 mm. The fovea centralis is 0.2 mm. in diameter. But does no importance attach to the investigation of the eccentric parts of the field of vision? In times, not many years since, it was but little regarded. True, if one-half the field were lost, the condition was recognized under the name hemiopia, and the lesion was invariably referred to the optic tract at the base of the brain. But accurate study of the visual field belongs to modern days. The normal extent of the field is of course greatest on the outer side and forms a figure of irregular outlines, being determined much by the configuration of the face, the depth of the globe, and the prominence of the nose and eye brows. We have learned that the field becomes restricted by such diseases as detachment of the retina, by retinitis pigmentosa, by glaucoma, by atrophy of the nerve, and by disease of the brain. Again we find patches of blindness take place in the field, which may be dense and complete, or be partial and shadowy. These may or may not be attended by visible changes in the fundus oculi.

We find as the cause of these dim patches, or scotomata, hemorrhage into the retina, atrophy of the choroid, or local lesions, as in cases of amblyopia from abuse of tobacco, and from alcoholic poisoning. The scotoma may be central or peripheral. We decide its presence and extent by a black-board and bit of chalk mounted on the end of a stick, for

scotomata, and by an instrument called the perimeter for the peripheral limitations. I hope to show some illustrations of what we discover in this manner.

Another matter presents itself in this connection, viz: The test for color perception. Examination has discovered that all parts of the retina are not capable of responding to shades of color in an equal degree. For instance all the colors may be seen correctly within an area of about 30° vertical diameter, by 76° horizontal, but beyond that green is invisible. For a space 20° wider red can be perceived, beyond this limit it can no longer be distinguished. For about 20° more, blue is distinguished, while for the last 15° of the field it becomes impossible to recognize any color. The limits indicated are shown in a diagram taken from Landolt. This is the physiological fact for all persons, while in disease this function becomes disturbed in a variety of ways.

It was long ago known that some persons are found color blind for certain tints, most frequently for red, the condition called Daltonism, but the lack of color perception as an acquired lesion has been studied only in modern times. The condition demands attention not only as a token of disease, but because we trust our lives to railway engineers and to seamen, who in a great measure are guided in their judgments, and take their directions by the language of color signals. Think of committing the safety of an ocean steamer to the precision of a look-out, who must instantly be able to say whether an approaching ship shows her red light on the port or starboard bow:—which may be the green and which the red light he may be unable to tell. One of the cases where color test helps in diagnosis is that it is characteristic of tobacco amblyopia that the perception of red is extinguished over a large and central area of the field.

We have been discussing the percipient structure of the eye, the retina; let us turn to its optical part, the refractive media. This has long been a favorite study. Men like Kepler and Newton, Young and Brewster, have given to its investigation the efforts of their genius. I may not pause to relate what they discovered, but hasten to indicate what they left for their successors to accomplish. In this field of achievement none can vie with Helmholtz. To him we owe the means of measuring the curve of the cornea and lens in

the living subject and consequently the solution of the optical problem of the accommodation. He showed that the cornea is an ellipsoid with radii of different values in the vertical and horizontal meridians—that its axis does not coincide with the axis of the globe, but is to its outer side at an angle of about 5° . He proved that the act of accommodation is caused by increased convexity of the lens and chiefly of its anterior surface, and that the lens as a mass is not carried backward or forward; moreover, that the cornea takes no part in this function. Helmholtz, in solving this problem, made use of the images reflected from the surfaces of the cornea and lens, which Scheiner was the first to observe, when a candle is held before the eye in the dark. He measured the place of these images and their size by an instrument called the ophthalmometer, which had the distinguishing merit of eliminating the hitherto insuperable difficulty arising from slight and unconscious movements of the globe.

Another achievement which has made many calculations simple, and been of immense value in optical discussions, was the substitution by Listing of his so-called reduced or schematic eye for the natural eye, with its many refracting surfaces. He constructed a figure, which strictly represents the eye in an optical sense, in which only a single refracting surface need be taken into account. This figure, or Listing's reduced eye, is universally employed in physiological optics as the basis of calculations.

In 1860 there appeared in Holland the treatise by Prof. Donders, of Utrecht, on ametropia and its results, which was afterwards enlarged and translated by the New Sydenham Society, and received from its author the title of "Accommodation and Refraction of the Eye." This book of 635 pages, as we have it in English, is a storehouse of scientific investigations and practical deductions. It differentiates in the clearest manner the various possible optical conditions of the eye. It is the foundation of our therapeutics, in the choice of glasses. Donders made it possible to prescribe spectacles upon a correct scientific basis. It has been asked, with some alarm, whether the manifest increase in the use of glasses does not betoken a deterioration of the race in vision. Formerly we had only two conditions to be provided for: 1st, the near-sighted person required his concave glasses; and

2d, the man getting into respectable middle life with a half apology would furtively slip on an eye glass and berate the horrible work of the newspaper printers. But now young and old, matrons and maids, wear glasses, and the public come to the oculist demanding a formula to be carried to the shop of the optician. We still have among us the peddling dealer, who offers to cure all your troubles with his ready wares, especially if you will invest in Brazillian pebbles, but he is going to the company of the razor-strop man and the mock-auctioneer.

Optical errors resolve themselves into the following groups : First, weakness and decline of accommodation, which, when it reaches a certain degree, is called presbyopia, and is the cause for the ordinary use of glasses between forty and fifty years of age; and as the decline continues with increasing age, the glasses must be made stronger and stronger. But it must be remarked that the abatement of accommodation begins so early as fifteen, and steadily goes on through life, until it becomes so much reduced that resort must be had to glasses.

The second error is hypermetropia or hyperopia, which implies that the antero-posterior axis of the eye is too short. This condition belongs to the original structure of the globe, and it may vary in degree between wide extremes. If the axis of the eye be taken at 21 mm. between the outer surface of the cornea and the rods and cones, a shortening of only one millimeter calls for the aid of a convex lens of ten inches focus. The error may go as high as a shortening of three millimeters, which compels the use of a glass of about three inches focus. It is because of this kind of error that persons wear magnifying glasses long before the time when presbyopia sets in. To such persons, strain on the accommodation is a constant necessity; if the error be moderate—that is, hyperopia not greater than $\frac{1}{12}$, they may go to fifteen or twenty years of age before great inconvenience is felt, but they must use glasses at an early age to relieve themselves of the strain which their deficient refractive force imposes.

The third error is myopia. This is almost always an acquired fault, appearing at from seven to fifteen years of age, and consists in an elongation of the optical axis. It is in direct contrast with hyperopia, although both are alike, in

that the back of the eye is the part concerned. Distension of the back part of the sclera causes myopia, and the unfortunate part of this defect is not so much in the inconvenience which it causes to sight for distance, but that the stretching of the sclera too often inflicts upon the similarly stretched choroid and retina an amount of structural mischief which no glasses can correct. The myope may boast of the value of his sight for minute objects, and find his distant vision satisfactory when he uses suitable glasses, but too often he is much deceived as to the supposed strength of his eyes, and may be the victim of serious and even destructive changes in the deeper parts of the eye. A warning has in late years well been raised against the pernicious arrangements of school-rooms and study-rooms—against the evil habits of children crouching over books with bent head, and poring over tasks or story-books in dim light, of badly adjusted seats and tables, of permitting a weakly lad to neglect the play-ground because he is so easily kept quiet by a book. These are the ways by which myopia is brought on, and while the condition may be, and to some degree, is hereditary, it is a disease.

A fourth optical error to be named differs entirely from the above, in being caused by a want of correctness in the shape of the refracting surfaces, or want of homogeneity in their substance. This is called astigmatism, and may be of a regular or of an irregular type. It may complicate other optical errors and consequently will have various special designations, as hyperopic astigmatism, myopic astigmatism, mixed astigmatism or simple astigmatism. It is not needful to expatiate on this topic, which at a former meeting I had the honor to illustrate before you. The error is by no means rare, and since its discovery a great amount of distress has been relieved and a great number of glasses been ordered. The glasses are unlike the usual kind in that they have at least one surface ground on a tool which is not a section of a sphere but a section of a cylinder. The refracting power of the glass is therefore nothing along a line which is called its axis, and rises to a maximum on a line at right angles to the axis. I have in my possession a pair of cylindric glasses which were worn by a gentleman who was once chaplain to the Utica Asylum for the Insane, and were made by

McAllister, in Philadelphia, about the year 1828. While Donders elucidated this subject so as to throw it into the general stock of ophthalmic knowledge, others had before his time observed it, when they were themselves personally affected by it. The most distinguished of these was Thomas Young, who wrote upon it in 1807.

If now I put together what I have sketched as optical errors, it will readily be understood that upon an obscure corner of ophthalmic study, a flood of light has been poured. The patients who formerly resigned themselves to a life-time of discomfort, pain and disability, because they were told they had asthenopia, nervous weakness, irritable retina, or incipient amanrosis, now comfort themselves with suitably selected glasses and enjoy the use of their eyes and the activities of life.

We are led from this subject to one which at first sight would not seem cognate, but which is truly very near of kin. We owe to Donders the distinct knowledge that the great proportion of cases of converging strabismus, depend on hypermetropia, while one of the chief discomforts associated with myopia, is found in feebleness of the converging muscles. If the feasibility of rectifying squint is to be credited to the surgery of another generation, the knowledge of its etiology, and how the lost function of binocular vision is to be restored, when this is possible, belongs only to very recent science.

I can only allude to this matter, and may add in passing, that the subject of muscular disorders of the eyes has grown into a large chapter; that the physiology of the muscles has been worked out with mathematical exactness; that on this field surgical operations have won most signal triumphs; and that the availability of prisms in mitigating or curing some of the disorders of the muscles, has added its quota to the increase in the number of glasses which the community are wearing. As an illustration of the penetrating genius of Graefe, I may say that the first article with which he opened his journal, the *Archives of Ophthalmology*, was an elucidation of the functions and disturbances of the superior oblique muscles.

There are other disorders of the refractive apparatus which demand attention. Conical cornea was formerly an incurable

malady. It has been successfully dealt with by surgical means, and most notably by Mr. Bowman, who taught us to excise a small disc with a trephine, and at a subsequent period make an artificial pupil. This proceeding confers a useful amount of sight. Moreover the glaring opacities left upon the cornea by inflammation, are made less conspicuous and their evil effect on sight abated, by saturating them with pigment, in other words, by tattooing them as sailors decorate their skin with pictures in india ink. The permanency of the pigmentation is not yet satisfactorily secured.

No subject in ophthalmology has attracted such attention as cataract. In no case of human woe is the triumph of the healing art more signal, than when the patient blinded by cataract, is restored to sight and happiness. On this theme I might linger long to tell what recent times have added to the knowledge and achievements of our predecessors. A fundamental fact is this, that we are infinitely better able than were they to discover cataract, and ascertain what complications may attend it; we understand far better the varieties and the structure of cataract. The ophthalmoscope and the method, so called, of oblique illumination, inform us what is the kind and stage of cataract, and we have learned much about its pathology.

But what of our ability to cure the malady? Our better knowledge of its nature and varieties has made us more discriminating, and therefore more fortunate in our methods. We recognize the congenital nuclear cataract, and for certain grades we do iridectomy; for higher degrees of this opacity we perform discission. We are cautious in the use of the needle, lest a rude disturbance bring on violent and possibly fatal reaction. For a cataract which is pulpy and swollen, it may be a traumatic cataract, we make a free paracentesis, which shall evacuate most, if not all, of its substance. The same treatment may be applied to spontaneous cataracts for which discission has already been done. We call this operation simple linear extraction. For certain special cases of senile cataract, we extract the lens and its capsule together. For some immature cataracts we make a preliminary iridectomy, which diminishes the risk of the subsequent extraction. These proceedings, if not all of them unknown to our predecessors, were not adopted into their daily habit of thought and practice.

We differ from their methods of treatment of hard cataract in two most essential respects :

First—We have discarded the operation of pushing the lens into the vitreous by whatever method performed ; knowing that choroiditis or other inflammation will sooner or later destroy at least one-half of the eyes thus treated.

Second—We extract hard cataract, no longer by a large corneal and semi-circular wound, called flap extraction, but by a straighter and more peripheral cut, which is much shorter, which lies almost in a great circle of the globe, and therefore heals with readiness. We also facilitate the expulsion of the lens by cutting out a sector of the iris, and by this proceeding risks of inflammation are much reduced. We keep the lids apart by a speculum instead of trusting the fingers of an assistant, and we secure the steadiness of the eye by holding it with forceps. The period of healing is abbreviated and the irksomeness of confinement is much alleviated. Our improved mode of operating, we have received from Albrecht von Graefe. You may well wonder that in a professional life of only one score years, so much was accomplished.

It remains to apply the crucial test, whether our modern method is really a gain upon the older operation. What do the facts prove ? Let me give you some statistics.

Of flap extractions done between the years 1756 and 1868 by thirty-nine operators, I have collected 10,094 cases. The proportion of cases of total loss of the eye is 16.7 per cent. From 1866, when Graefe first published his operations, to 1877, I have collected of peripheral linear extraction, 10,661 cases, done by seventy operators. The proportion of total loss was 6.5 per cent. Graefe informs us that previous to 1865 he had done 2,500 operations of flap extraction and had a loss of 10 per cent. That by the new method he had done over 1,000 cases up to the year 1879, when he wrote his last article, and had a loss of less than 3 per cent.

There can be no doubt that for the great mass of persons blinded by cataract, Graefe's method is to be preferred. It may also be admitted that for selected cases, flap extraction may give better vision when it succeeds. There are some other modern methods of operating for cataract, but they have not gained general approval. They are valuable for special cases, and are resorted to when occasion demands.

Up to this point I have barely hinted at what the ophthalmoscope has done for ophthalmology. We need no longer arrest our inquiry into the condition of the eye when we reach the crystalline lens. The pupil is not to us what it was to our ancestors—a door open, yet shut; a way for light to pass, yet forbidding any to peer through it. What to the eye was light, to them was darkness.

I shrink from attempting to lay before you what the ophthalmoscope has given us. The field is too large for anything but the most cursory sketch. What is to be seen is only revealed to the instructed observer. Not a little has been asserted to be seen, which was mistakenly seen. What we discern, is in general as follows: We can pass judgment on the eye as an optical instrument and say whether its refraction be normal or erroneous; and if the latter, whether it have myopia, hypermetropia or astigmatism, and approximately what glass will correct the fault. We have thus an independent control of the selection of glasses, uninfluenced by mistakes or morbid conditions of the patient.

We examine the vitreous body, the optic nerve, the retina and the choroid up to within about 5 mm. of their periphery. The ciliary body and the posterior surface of the iris are hidden from us. I shall not weary you with any detail of the pathology of these structures. We can view them by the upright method of ophthalmoscopy with a magnifying power of about fourteen diameters for emmetropic eyes, and with the inverted image can cover more space with a power of four to six diameters. In any case we do not usually have in one field, more surface than two nerve diameters.

For all the forms of blindness formerly called amanterosis and amblyopia, we are able to find local lesions, with the exception of a comparatively few cases. There are certain cases in which the lesion is in the minute elements which we cannot see, or it lies in the cerebral centre and has no ocular expression. If I leave out of view almost all the exclusively local lesions of the inner eye, I should do wrong to omit allusion to the disease glaucoma. Not until the deep chamber of the eye was made luminous, was this disease understood. At the first the strange appearance of the optic nerve was misinterpreted; but H. Muller soon ascer-

tained the fact of its excavation by pathological examination. When this became known to Graefe he instantly grasped the key which unlocked the mystery of the symptoms. He saw that the central fact was excessive intra-ocular pressure. Having noted that iridectomy had in many eyes the effect of reducing their tension below the normal standard, he applied the operation to cases of glaucoma, and gave to the world a cure for an incurable malady. The disease has various phases, and the success of the operation varies according to its stage and type. The all important injunction is to be given, that to be effective the operation must be done early. To recognize it early needs attention to a few marked symptoms; foremost, the hardness of the eye ball under the touch of the finger, next, the impaired sight, and next the restriction of the visual field, especially on the nasal side, although to this symptom there are exceptions. In any event a hard eye ball is not to be overlooked, and a proper ophthalmoscopic examination should immediately follow.

Let me now bring to your notice certain lesions which link ophthalmology with general pathology. We have neuro-retinitis which is idiopathic, but it comes likewise from disease of the kidneys, and may appear during pregnancy or after scarlet fever. It comes also as a result of diabetes mellitus, of syphilis, and of leucocythemia. It occurs as a complication of Bright's disease, in frequency variously stated at from ten to thirty per cent. of the cases. Neuro-retinitis, neuritis optica, papillitis or choked disc, and atrophy of the optic nerve, are frequent effects of diseases of the brain. In eighty-eight cases of cerebral tumor, it has been stated that choked disc took place in 95 per cent.

Hemorrhages into the retina take place when there is disease of the heart, when the vessels are in an atheromatous state and in pernicious anemia. Retinal apoplexies are looked upon as being often significant warnings of possible cerebral apoplexy. So, too, embolisms occur in the retinal vessels. Lead poisoning, locomotor ataxy, or other diseases of the spinal cord, as well as sclerosis of the brain, may make their mark in the eye as atrophy of the optic nerve. Thus I might go on with further detail, but the waning hour bids me pause.

Will your patience indulge a glance at the last researches into cerebral function in so far as they touch upon ophthalmology. We are told by Ferrier that certain convolutions of the brain preside over certain functions of the body. He has designated a certain spot which is the centre for vision, and another spot which if it be irritated, is followed by very remarkable effects upon the eye. This latter spot is at the base of the first frontal and extends partly into the second frontal convolution near the median line; when it is irritated, say upon the left side, the eyeballs are turned strongly to the right and cannot be turned fully to the left, the lids open widely, the pupils dilate, and the head turns to the right.

Moreover, if a section be made of the deep part of the crus cerebri external to the optic thalamus, hemi-anæsthesia takes place, affecting the opposite side of the body; there may also be some temporary motor paralysis. Besides this, the senses of taste, of smell and of hearing, are partly or totally abolished. There is also a peculiar affection of sight. A dimness, but not abolition of vision, occurs in the opposite eye, associated with a remarkable contraction of the field of vision and a loss of perception of color. The discrimination of violet, of green and of orange, is lost, and in extreme cases the yellow and blue, which are the colors always best perceived, likewise disappear, and merge into a uniform sepia tint. It has also been shown by Landolt that the fellow eye, to a slight degree, participates in the symptoms. The ophthalmoscope can detect no evidence of these lesions. The above named group of symptoms on the part of the special senses and of the general sensibility are certainly most remarkable.

Yet another new fact awaits our attention. As we trace the optic nerves back from the eye balls they meet and combine in the chiasm, and then under the name of optic tracts pass around the crura cerebri into the brain. At the chiasm the optic tracts perform a partial decussation. It has within a few years been attempted to be shown that they make a complete crossing, as is the case in fishes and in some other animals, but the latest conclusions re-establish the older opinion first advanced by Wollaston, of partial crossing. It results from this that the right half of each eye is supplied by the left optic tract, and the left half of each eye by the right optic

tract. Hence lesions behind the chiasm will cause hemianopsia, or half blindness, the line of demarkation running not through the optic nerves, but through the centre of the retinae. Cases of this sort have long ago been noted. The optic tracts have been supposed to terminate upon the tubercula quadrigemina. But Ferrier and others have shown that destruction of a convolution on the surface of the posterior and inferior part of the hemisphere, known as the angular gyrus, is followed by total blindness in the opposite eye. Injury on one side in front of the tubercula quadrigemina and behind the chiasm causes half blindness of each eye, but injury of one angular gyrus causes total blindness of the opposite eye, leaving the corresponding eye untouched. After a time sight may be recovered in the lost eye—a remarkable fact explained by supposing the visual centre of the other hemisphere to act in a compensatory manner. If the angular gyri of both hemispheres be destroyed, permanent blindness ensues, in both eyes. In these phenomena we have evidence of anatomical relations between the optic tracts never before suspected. As Charcot suggests they must intermingle by decussation of their lateral or external halves, after they reach the tubercula quadrigemina. A diagram which he gives explains the hypothesis. It is indeed, something to know that we have possibly found upon the cortex of the brain, the precise spot where the intellectual or mental centre of the sense of sight, resides. In regard to it, Ferrier remarks that with the loss of the eye balls, the memory of sight and the mental representation of visible objects remains; but upon destruction of the angular gyri the very conception and memory of vision is blotted out and made impossible.

Mr. President and Gentlemen—I must not longer presume upon your patience. There are other themes in ophthalmology which deserve presentation, such as the sympathy which exists between the two eyes in their pathological condition, the modern knowledge of binocular or stereoscopic vision, and the great practical subject of the therapeutics of the eye both in general principles of management and in the use of local remedies. I have said nothing of the new agents which have special properties peculiar to the eye, or of the improved methods of using the older remedies.

Neither have I more than hinted at the great service which has been done by operative surgery as a therapeutic means, in controlling diseases of the eye. These topics and others must be passed in silence.

What I have narrated has not been in the spirit of boasting. Neither would I depreciate the merits of the generations who have preceded us. It were a disgrace to us did we not occupy a place more advanced than theirs. They bequeath to us the legacy of their labors ; and the gifts of science are not treasures to be hidden in chests, but trust funds to be utilized and expanded into wider capacities for good. Ophthalmology, like the rest of medicine, is both a science and an art ; it has become an infinitely more beneficent art since it has grown to be a more exact science ; while the appeals of humanity to the resources of art lay upon science the most urgent claim to open to us more of her secrets and disclose the means whereby we may preserve our fellow men from the ravages of disease.

